VI. ANALYSIS OF WATER SUPPLY ALTERNATIVES

Ground water is the most significant source of the water supply for urban and agricultural demands in the LWC Planning Area, and it is anticipated that it will continue to be the most significant source of water for these needs in the foreseeable future. Both the continuously increasing demand for ground water as well as historical flood control and drainage practices have caused local and regional declines in ground water levels. Ground water declines are expected to increase in the future, due to the projected increases in ground water demands. A variety of adverse impacts may be associated with long-term declines in ground water levels. These adverse impacts can be separated into three generalized categories: (1) environmental resource impacts, (2) ground water resource impacts, and (3) geotechnical impacts.

Environmental resource ~~impacts are generally caused~~ by decreases in the amount and duration of water occurring at, or immediately below, the land surface. An example of this is a decrease in the seasonal inundation for a particular wetland system that leads to a change of species composition or distribution. Ground water resource impacts are those which result in a decrease in the quantity or quality of water available from an aquifer or aquifer system. Examples include seawater intrusion, movement of saline water into a freshwater zone, aquifer compaction, and decreased well yields. The geotechnical category includes impacts which may not harm the quantity or quality of water available from an aquifer, but are, nevertheless, significantly adverse. Examples of geotechnical impacts include regional land subsidence and local sinkhole formation. Physical changes to wells such as collapsed casing and/or screens, encrustation and/or air blockage of screens could also be placed in this category.

A five-step process was used to define criteria which when exceeded may result in adverse impacts as described above when applying these criteria to existing and future demand scenarios:

1. Identify potentially significant adverse impacts. The potential adverse impacts caused by ground water level drawdowns were identified. Adverse impacts which could be significant were identified for further analysis.

2. Determine levels of significance. This is an evaluation of those declines in water levels that may cause significantly adverse impacts. This step essentially requires the determination of thresholds at which the adverse impacts from water level declines are considered significant. This can be difficult. Often the relationship between water level declines and the resulting impacts may not truly be a threshold phenomenon. In other cases the threshold may not be known, or the frequency and duration of a drawdown may be more important than the amount of drawdown. Published research and the experience of various experts are used to assess significance, but determining a threshold of significance ultimately requires judgment.

3. Develop resource protection criteria. These criteria are essentially minimum ground water levels that were developed both for ongoing planning purposes and for future regulatory authority. Resource protection criteria for this plan were developed with consideration to all four of the principal elements of the SFWMD's mission, and are used in this plan in three ways: (1) to define excessive water-level decline in the context of this plan, (2) to identify where excessive declines might occur in the future using ground water flow models,

and (3) to assist in evaluating the effectiveness of alternative modeling scenarios in avoiding or mitigating the adverse impacts of excessive water-level declines.

4. Simulate water levels. Ground water flow models were used to predict water levels in the aquifers based on simulated conditions of rainfall and water demands in the year 2010.

5. Locate areas not meeting resource protection criteria. The simulated ground water levels produced by ground water flow models are compared to the resource protection levels to identify potential future problem areas. This step was accomplished utilizing a variety of tools including geographic information system software.

Based on the results of this five-step process, alternative modeling scenarios were developed and modeled to decrease the extent of areas which did not meet resource protection criteria. These scenarios included: (1) changes to projected water demands, (2) changes to new water sources, (3) changes to District operations, and (4) various combinations of these scenarios. The results of the alternative modeling scenarios were used to develop specific recommendations intended to minimize future adverse impacts. These recommendations are found in Chapters III and IV of the Planning Document.

RESOURCE PROTECTION CRITERIA

Three resource protection criteria were developed for analysis using ground water flow models. These criteria are standards to measure the level of protection of both wetlands and the ground water resources a number of adverse impacts caused by the pumping of ground water. The criteria include specific definitions of the severity, duration, and frequency of excessive declines in ground water levels.

Wetland Protection Criterion

The potential for impacts to natural systems as a result of ground- and surface-water withdrawals to meet future demands is of concern. Withdrawals can alter the natural hydrology by lowering ground- and surface-water levels and reducing hydroperiods. Hydrology is the single most important factor in determining the type of vegetation that occurs across the landscape. Fire frequency and soil type are additional important factors that are often closely related to hydrology. Man-induced alterations in hydrology can affect species composition and distribution as well as the functions and values of natural systems.

Current District rules are narrative in nature and do not clearly define what impacts are considered unacceptable to natural systems with regard to altering their hydrologic conditions. This narrative rule has been translated to a guideline that withdrawals must not lower the water table by more than one foot under a wetland after 90 days of maximum pumpage with no recharge. Development of better criteria in terms of severity/duration/frequency is needed to reflect the District's current understanding of natural system needs. This will be accomplished through a team approach using the departments of Research, Planning, and Regulation. The Research Department is working to define the requirements of natural systems. The Planning Department will bring forward the concepts and results of research through the planning process, to the public for review and input. The Regulation Department will then initiate rulemaking changes and implement the new rules on a day-to-day basis.

The specific wetland protection criteria identified the potential of impacts to wetland systems from future ground water withdrawals. The analysis used simulations of man-induced drawdowns of the water table aquifer for the year 2010. These simulations were generated by ground water flow models and were stated in terms of severity, duration and frequency of drawdowns. The projected water table aquifer drawdowns was then evaluated with respect to regional wetlands systems in the LWC Planning Area.

This analysis included an evaluation of current regulatory guidelines for drawdown under wetlands as well as evaluation of alternative guidelines. Variations on the future water use and withdrawal scenario were also incorporated into the analysis. Recommendations for specific wetland protection drawdown criteria were formulated and presented. The recommended criteria is based on the need to prevent significant harm to natural systems while providing adequate water to meet future demands.

Seawater Intrusion Criterion

This criterion applies to selected locations along the Gulf Coast in Lee and Collier counties based on evidence of historical seawater intrusion or upon geologic evidence of susceptibility to seawater intrusion at these locations. Minimum allowable ground water levels in the Intermediate and Surficial aquifer systems were chosen for these locations to prevent seawater intrusion except during more extreme drought events. The seawater intrusion criterion is generally defined as follows: Ground water levels should not decline below the criterion level for any period of time during any drought event that occurs more frequently than once every ten years.

General Aquifer Protection Criterion

The general aquifer protection criterion applies to all locations in the LWC Planning Area, and is based on the recognition that certain declines in ground water levels are potentially associated with a number of significant adverse impacts including reduced well yields, aquifer compaction, land subsidence, sinkhole formation, and brine migration. To prevent such impacts, minimum allowable ground water levels (criterion levels) are set at an elevation above the top of the aquifer. The distance from the top of the aquifer to the general aquifer protection criterion level is approximately the uncertainty associated with knowing where the top of the aquifer actually is. For example, if the top of the aquifer is estimated to be at an elevation of 50 feet below sea level with an uncertainty of 10 feet (i.e., -50 feet plus or minus 10 feet), then the criterion levels would be set at an elevation of 40 feet below sea level. The general aquifer protection criterion is defined as follows: Ground water levels should not decline below the criterion level for any period of time during any drought event that occurs more frequently than once every ten years.

MODELING ANALYSIS OF RESOURCE PROTECTION CRITERIA

Ground Water Modeling Approach

Ground water flow models were used in this plan to help evaluate excessive ground water declines during long-term average hydrologic conditions (steady-state conditions) and during short-term dry periods (transient conditions) when water demand is high and the supply, ultimately derived from precipitation, is low. The ground water simulation periods for short-term dry periods ranged from 12 to 24 months in duration. The dry periods were extracted from historical rainfall records for Collier, Hendry and Lee counties in tables C-2 through C-4 (Appendix C). These simulation periods were chosen because most droughts in South Florida are of two years duration or less. The models simulated ground water levels in response to current and future demands from the aquifers.

Three separate site-specific ground water models were developed by the SFWMD using generic computer code prepared by the U.S. Geological Survey (McDonald and Harbaugh, 1988) as well as site-specific information representing hydrologic conditions. The geographic areas represented by the models are shown in Figure VI-1. The models, although complex in many respects, are simplified representations of the real hydrologic systems and processes, and they incorporate certain assumptions concerning the physical characteristics and processes occurring in the real hydrologic systems. The hydrologic processes simulated by the ground water models included: (1) horizontal and vertical ground water flow in response to differences in water levels; (2) ground water recharge from precipitation; (3) flow to and from major rivers and ground water; (4) drainage from ground water to major canals and drains; (5) evapotranspiration; (6) return flow (deep percolation) of applied agricultural irrigation water; (7) ground water pumping for public water supply; and (8) ground water pumping for agriculture and other irrigated demands. The details of how these processes are simulated by the models can be found in other District publications (Bower *et al.*, 1990; Smith, 1990; Bennett, 1992).

Major aquifers occurring in the LWC Planning Area are represented as individual layers in the ground water models. Within each layer there is a grid of squares, or cells, each having an area of one square mile. Solutions to the various ground water flow model scenarios utilized for this plan yielded water levels that are representative of the entire volume of each cell.

The approach to modeling ground water conditions in the year 2010 involved the identification of a hypothetical set of conditions representing future water demands. This hypothetical set of conditions is collectively referred to as the base case for the purposes of this report. The hypothetical conditions, or assumptions, of the base case represent a view of the future if no additional water supply or water conservation measures are implemented beyond those which are currently mandated.

Demand Assumptions

The water supply for urban and agricultural demands are represented as withdrawals from specific layers of the ground water models. These demands have been summarized previously in Chapter IV of this volume. The categories of urban and agricultural water demand are combined somewhat differently for use in the model simulations than was presented in Chapter IV. In general, there are two categories of water demands used by the flow models: (1) seasonal water demands that vary by calendar month but which do not vary as a function of specified monthly

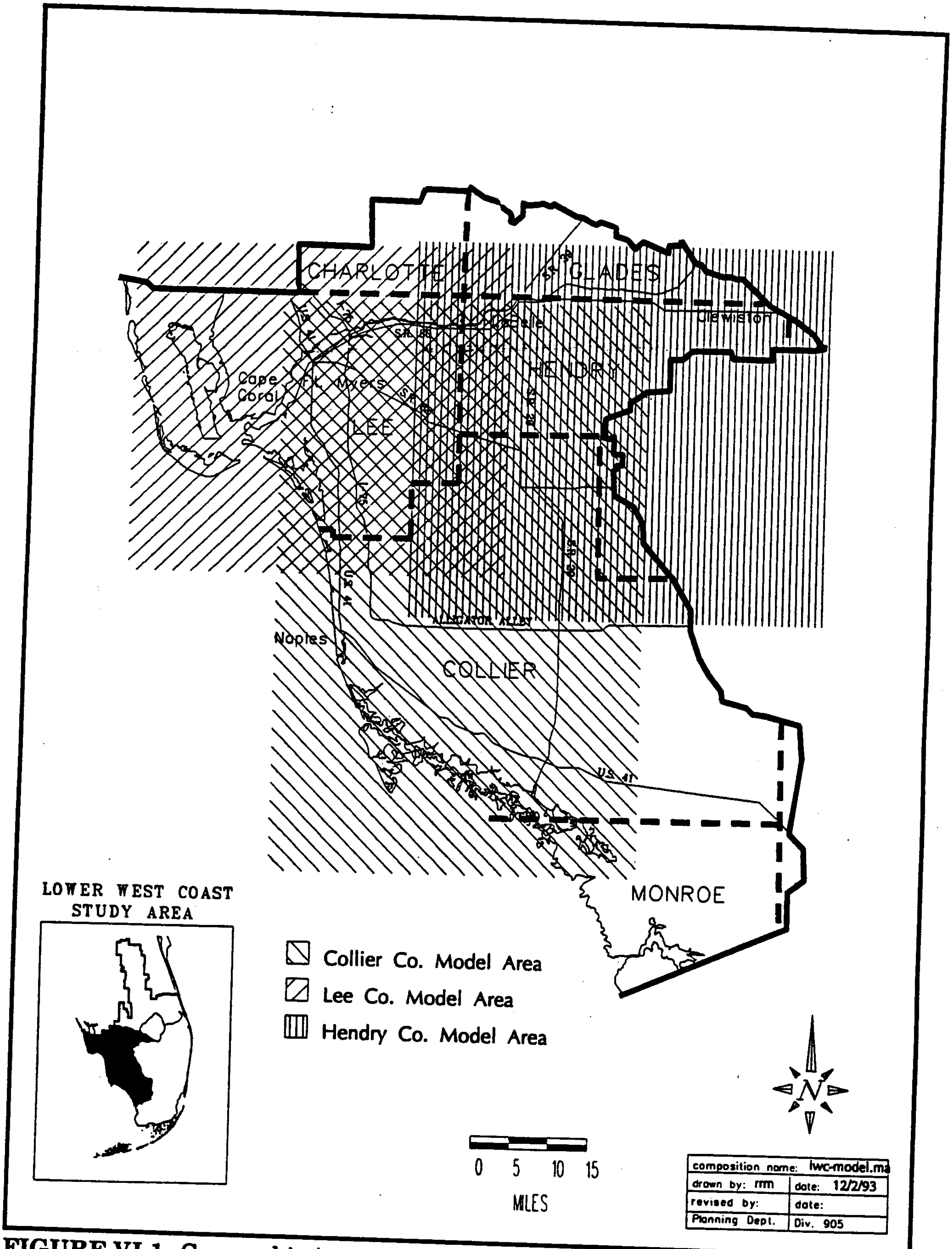

FIGURE VI-1. Geographic Areas Represented by Ground Water Models.

rainfall amounts, and (2) water demands that are explicitly dependent upon precipitation and that vary as a function of the specified monthly rainfall amounts. The first category generally includes public water supply provided both by utilities and individuals (domestic self supply). The second category includes all of the agricultural water demands as well as landscape and golf course irrigation.

Public Water Supply

The simulation of ground water pumping for public water supply was based on population estimates and per capita water consumption compiled from various information sources. Ground water pumping for public water supply was adjusted for seasonal variation in demand based on average values for calendar-month time periods. The per capita demands for water provided by utilities were adjusted downward for the year 2010 to reflect a number of mandatory and voluntary conservation measures, as described in Chapter V, that will be in place by 2010.

Agricultural Water Demands

The simulation of ground water pumping for agricultural water supply was based on crop acreage, crop type, and specified monthly rainfall amounts. The actual and projected irrigation demands presented in Chapter IV are based on historical crop acreage data, as discussed in Appendix G. These data were available on a county level, which lack the resolution to identify problem areas in the ground water model grids. Therefore permit data, which show the locations of permitted withdrawals, were used in the modeling process because these data have the level of resolution required by the ground water models. The permitted demand level for 1990 was used to represent the 1990 irrigation demands. To represent the 2010 demands, the projected demand data for 2010 were developed using the methodology described in Appendix G.

The 1990 permitted demand is considerably higher than the actual 1990 demand level presented in Chapter IV because considerably more agricultural acreage was permitted in 1990 than was actually planted. Actual crop acreages are usually less than the permitted acreage due to the lags between permitting and planting. The 2010 projected land use represents anticipated actual land use rather than forecast permitted land use.

Alternative Modeling Scenarios

A systematic, analytic process was followed in developing final recommendations for the Lower West Coast Water Supply Plan. The first step of this process involved applying the demand assumptions and resource protection criteria described above using the ground water models to arrive at 1990 and 2010 base case model results. The base case results were used as the constant, or measuring standard, when analyzing regional alternative modeling scenarios. The base case runs assumed no changes to the current methods of supplying water to the lower west coast; they simply portrayed what might occur if 1990 and 2010 water demand were applied against the resource protection criteria and all other conditions remained constant. Measurable results were counted in terms of wetland impacts, saltwater intrusion and aquifer protection criteria being exceeded.

Next, a series of regional alternative modeling scenarios were developed and analyzed using the ground water models. The results of the alternative model scenarios were compared to the base case model results using the following measures:

(1) The total area of wetlands (in acres) in which wetland criteria were not met.

(2) The number of coastal model cells in which seawater intrusion criteria were not met and the number of months during a simulation when these model cells did not meet the criteria.

(3) The number of model cells in which seawater intrusion criteria were not met and the number of months during a simulation when these model cells did not meet the criteria.

The following model scenarios were simulated for this plan:

Scenario 1 - Remove public water supply demands from the shallow aquifers. Two variations on this model scenario were simulated for both Collier and Lee counties. Public water supply demand is a relatively small component of the total demand in Hendry County, so scenario 1 was not simulated for Hendry County. All public water supply withdrawals were removed from the shallow aquifers in scenario 1a. This scenario eliminated any problems in not meeting the resource protection criteria due to public water supply withdrawals. In scenario 1b, the increase in public water supply withdrawals between the 1990 permitted demand level and 2010 projected demand level was removed from the shallow aquifers. Scenario 1b isolates the effect of the increased public water supply demand with respect to meeting the resource protection criteria. Although both modeling scenarios 1a and 1b remove the public water supply demand from the shallow aquifers, neither scenario specifies nor simulates an alternative source for these demands. The most probable alternative source for these demands is the Floridan aquifer system; however, simulation of flow in the Floridan cannot be done with the existing models.

Scenario 2 - Reduce agricultural water use by increased irrigation efficiency. Three variations of this modeling scenario were simulated. In scenario 2a, the irrigation efficiency for small vegetable crops was increased to 75 percent for all users currently below that efficiency level. In scenario 2b, the irrigation efficiency for citrus was increased to 85 percent for all users currently below that level. Scenario 2c was a combination of scenarios 2a and 2b. All three model scenarios were simulated by reducing irrigation withdrawals for small vegetable and/or citrus crops in the model runs.

Scenario 3 - Increase use of reclaimed water. The total amount of reclaimed water available for irrigation was assumed to be the average of the three minimum flow months for each regional wastewater treatment plant in the LWC Planning Area for 2010. Wastewater flows exceeding the simulated irrigation requirements and flows for which an application area could not be defined were assigned to the treatment plant's alternative disposal source and/or to demands not incorporated in the model. This scenario was simulated by reducing well withdrawals and replacing them with reclaimed water.

Scenario 4 - Implement proposed long-term modifications of the Big Cypress Basin canal system. Modifications to this canal system included elimination of canals in the South Golden Gate Estates area and addition of control structures on the Miller and Faka Union canals directly north of Alligator Alley. Control elevations for the new structures were set at one foot below land surface to maintain higher water levels north of I-75. This scenario is specific to Collier County and was simulated with the Collier County model by adjusting the simulated canal levels accordingly. The proposed modifications to the Big Cypress canal system include facilities for backpumping water to the north Golden Gate Estates area and other routing of surface water through the canals; however, these modifications cannot be fully represented in the ground water model. A watershed management plan will be developed by the Big Cypress Basin Board within the next year. This watershed management plan should be able to provide more detailed evaluations of the benefits of the proposed modifications.

Scenario 5 - Combination of Scenarios 1 and 3. This scenario has two variations. Scenario 5a combines scenario 1a, in which all water supply withdrawals were removed from the shallow aquifers, with scenario 3, in which irrigation withdrawals were partially replaced by reclaimed water. Scenario 5b combines scenario 1b, in which the increase in public water supply withdrawals between 1990 and 2010 were removed from the shallow aquifers, with scenario 3.

Scenario 6 - Evaluate combination of Scenarios 1, 2c, and 3. Modeling scenario 6 had two variations: (1) scenario 6a, which combined modeling scenario 1a (remove all public water supply from the shallow aquifers), modeling scenario 2c (improving the irrigation efficiency of both small vegetables and citrus), and modeling scenario 3 (increase use of reclaimed water); and (2) scenario 6b, which combined modeling scenario 1b (remove **future** public water supplies from the shallow aquifers), modeling scenario 2c, and modeling scenario 3. Modeling scenarios 1a, 1b, and 3 involved urban water supplies and reclaimed water, neither of which are very large in Hendry County. Scenarios 1a, 1b, and 3 were not simulated for Hendry County. Similarly, modeling scenarios 6a and 6b were not modeled for Hendry County.

The results of the scenario analyses described above are presented in Chapter II of the Planning Document.

WATER SUPPLY ALTERNATIVES

Changes to Demand

Following is a brief description of several ways to change the demand for water. These changes were first put in the modeling efforts to estimate future impacts. If impacts of these actions were deemed appropriate, implementation would occur. Essentially, the methods described below modify the reasonable-beneficial requirement of Section 373.223, F.S. Chapter V of this document provides a more detailed discussion of the following alternatives and issues related to each.

Alterations to Supplemental Crop Requirements for Irrigation Use Class

It is possible for the District's rules to alter, by use class and/or crop type, the drought frequency upon which water is allocated. This translates to an alteration of protection from drought events, thus changing the certainty of permitted water rights. The more infrequent a drought event which is used to calculate an allocation occurs, the higher the quantity of water allocated. The allocation of water in this manner, then has the corollary effect of "locking-up" water from others' use, thereby reducing the supply (at the time of allocation) and restricting the water available for allocation to subsequent users. The allocation of supply to specified use classes/crop types will be accompanied by descriptions of geographic area, supply source impacted, linkage to water shortage triggers and, when implemented after rulemaking, permit duration.

Irrigation Demand Management

As with urban water demand, the District has implemented a series of irrigation demand management, or water conservation, techniques. These have been implemented primarily through the permitting process. However, in some instances it may be appropriate for this plan to recommend additional irrigation demand management techniques in areas where resource protection criteria are projected to be violated. By doing so, users would become more efficient, thereby, maximizing the amount of water available for irrigation.

Urban Demand Management

The District, in cooperation with local governments, has been successful in establishing and implementing a series of urban demand management, or water conservation, techniques. These have been implemented through a combination of permitting activities, local government ordinances, and public information. However, in some instances it may be appropriate for this plan to recommend additional urban demand management techniques in areas where resource protection criteria are projected to be violated. By doing so, users would become more efficient, thereby, maximizing the amount of water available for future development.

Source Changes

In some instances, it may be appropriate for the plan to recommend that a user, or group of users, pursue withdrawals from a different aquifer than one they are presently using. In the LWC Planning Area this usually means using the Floridan Aquifer System (FAS) as a new source. Chapter V explains several issues related to using the FAS, including water quality. The following paragraphs explain which use classes may likely be required to use the FAS and any criteria that must be considered when using the FAS.

Required Users. Several factors must be considered when evaluating which users should be required to pursue using the FAS. These factors include the location of FAS producing zones, the concentration or dispersal of users, and the efficiency of distribution. When these factors are evaluated it becomes clear that the most appropriate group of users to consider using the FAS is the urban group. Urban users, including utilities, are generally concentrated near the coast and can take advantage of a relatively compact distribution system.

Development Criteria for Alternative Aquifers. When developing criteria for requiring the use of alternative aquifers the following matters will be considered:

1. Minimum aquifer heads,
2. Aquifer degradation criteria,
3. Discharge of brine,
4. The use of pumps, and
5. Mitigation issues related to existing users.

New Source and Treatment Development

The plan recommends mandatory use of new sources. Treatment technologies necessary to use new sources are also discussed. Chapter V of this Background Document presents a thorough review of new sources and technologies including cost estimates for the new technologies. Following is a listing of the sources and technologies described in more detail in Chapter V:

a. Aquifer Storage and Recovery (ASR),
b. Wastewater Reuse,
c. Surface Water Storage, and
d. Alternative Technologies such as Reverse Osmosis (RO), Membrane Softening, Electrodialysis and Electrodialysis Reversal, Distillation, and Small Systems.

Source Reservation

In some areas, competition for limited resources creates a need to match the sources of water with specific water use categories. This is in keeping with the state's direction to use the lowest quality of water for the intended use, to maximize reasonable-beneficial use of water and to allocate under competitive situations to the user most in the public interest.

In defining which water use type best promotes the public interest, which are in part defined by the goals and objectives of the LWC Water Supply Plan, portions of water supply sources (surface and ground water) may be "zoned" to assign priority for a specific water use category when two or more categories of users are competing for the same water source. These zones can be based on those uses which are most reasonable-beneficial and most in the public interest in light of other uses. Zones may be based on the characteristics of the use itself as well as local government planning decisions. Supply source reservation will provide to water users advance notice of the District's definition of public interest in a competing use situation. Finally, when all rights to the specific remaining source are equal, consideration of the relative economic return of the proposed use will be the deciding factor.

Location of Public Water Supply Withdrawals. Portions of the Surficial Aquifer System underlying the urban coastal area could be zoned to assign priority for public water supply. Under this concept, other use types (industrial, commercial, agricultural) could be encouraged to consider other sources of water (surface water, reuse, Floridan, etc.).

Location of Agricultural Water Withdrawals. In situations where applicants are competing for water rights, portions of the surface water system or areas of the shallow aquifer could be designated to give agricultural uses a priority based on the industry's lack of water supply options in some geographic areas. Such a decision would have to be based on public interest tests, economic factors, and other considerations.

The assignment of priority might not preclude successful applications for water rights by other user categories, but could result in more stringent permit conditions, including: reduced drought protection; more stringent water shortage requirements; and shorter duration permits.

Location of Other Urban Withdrawals. In situations where applicants are competing for water rights, portions of the available water supply could be designated to give preference to other urban categories to reduce competition with public water supplies and to match sources with lower water quality with users which can tolerate the reduced quality. For example, in areas with brackish or saline water, or areas where saltwater intrusion is a concern, an area might be zoned for uses which are salt tolerant or which are able to remove salt.

Elimination of Unpermitted Domestic Irrigation in Critical Areas. The District does not require permits for domestic wells. In some areas, the aggregate effect of all these wells may impact a local water utility and may constitute a competitive use. Therefore under certain circumstances, the District could require the permitting of domestic wells, especially when competing against uses deemed more reasonable and beneficial, such as public water supply.

Mitigation Banking

Legislation passed in 1993 required the water management districts and FDEP to adopt mitigation banking rules for wetland impacts under Part IV of Chapter 373 F.S. by January 1994. These rules have been adopted and are currently in effect. Mitigation banks will provide an alternative to traditional on-site mitigation.

In the past, the SFWMD has permitted mitigation only for impacts associated with "dredge and fill" or storm water management projects. The Lower West Coast Water Supply Plan recommends that the District develop specific rules and criteria to allow mitigation for impacts associated with consumptive use withdrawals. Support for this concept is found in the legal interpretation of the term "reasonable-beneficial use" under the water use permitting criteria. When applying the reasonable-beneficial use test, several factors are balanced. These factors include the potential for environmental impacts, the ability to mitigate for such impacts and the social or public interest values of allowing impacts in order to take advantage of a water source. The prevention of harm "to water resources of the area" as required by Section 373.219 F.S., can be achieved by providing mitigation benefiting the ecological community of the area as a whole, even when localized harm occurs.

For example, there may be benefits to the public interest in using the last remaining economically viable source of water in an area for public water supply. These benefits may outweigh harm to a small, isolated, and degraded wetland, when the harm can be mitigated through enhancement of a nearby regional wetland. Without the use of mitigation in this type of a situation, an essential source of water would be locked away from development in order to prevent harm to a marginal wetland, when mitigation could be utilized to offset the harm and benefit the water resources as a whole.

The mitigation banking concept is intended to provide long-term sustainability of mitigation efforts and to preserve the functional values of large wetland/upland systems. This need to focus on the long-term sustainability of large natural systems is consistent with the ONS concept that is described in Chapter III. The ONS map delineates the large, relatively intact natural systems within the LWC Planning Area. It can be used to identify potential mitigation banking areas.

Figure VI-2 identifies several areas within or adjacent to the ONS boundaries that have been impacted by human activities and have potential to provide mitigation through restoration and/or enhancement of the natural systems. Table

VI-1 contains a breakdown of the land cover types occurring within these areas. Potential mitigation opportunities for these sites include: removal and control of exotic species; filling of ditches and placement of structures within canals to restore hydroperiods; prescribed burning; and reclamation of agricultural areas to native wetland and/or upland communities. On-site inspections and detailed analyses are needed to determine the specific type of mitigation that may be appropriate for each of these sites.

There are also extensive areas within the ONS boundaries that have not been impacted by human activities. In these areas, there is potential to provide mitigation through acquisition and preservation of the existing natural systems. Most of the areas designated as ONSm have potential to provide mitigation through acquisition and preservation. This type of mitigation should be closely coordinated with the District's Save Our Rivers Program.

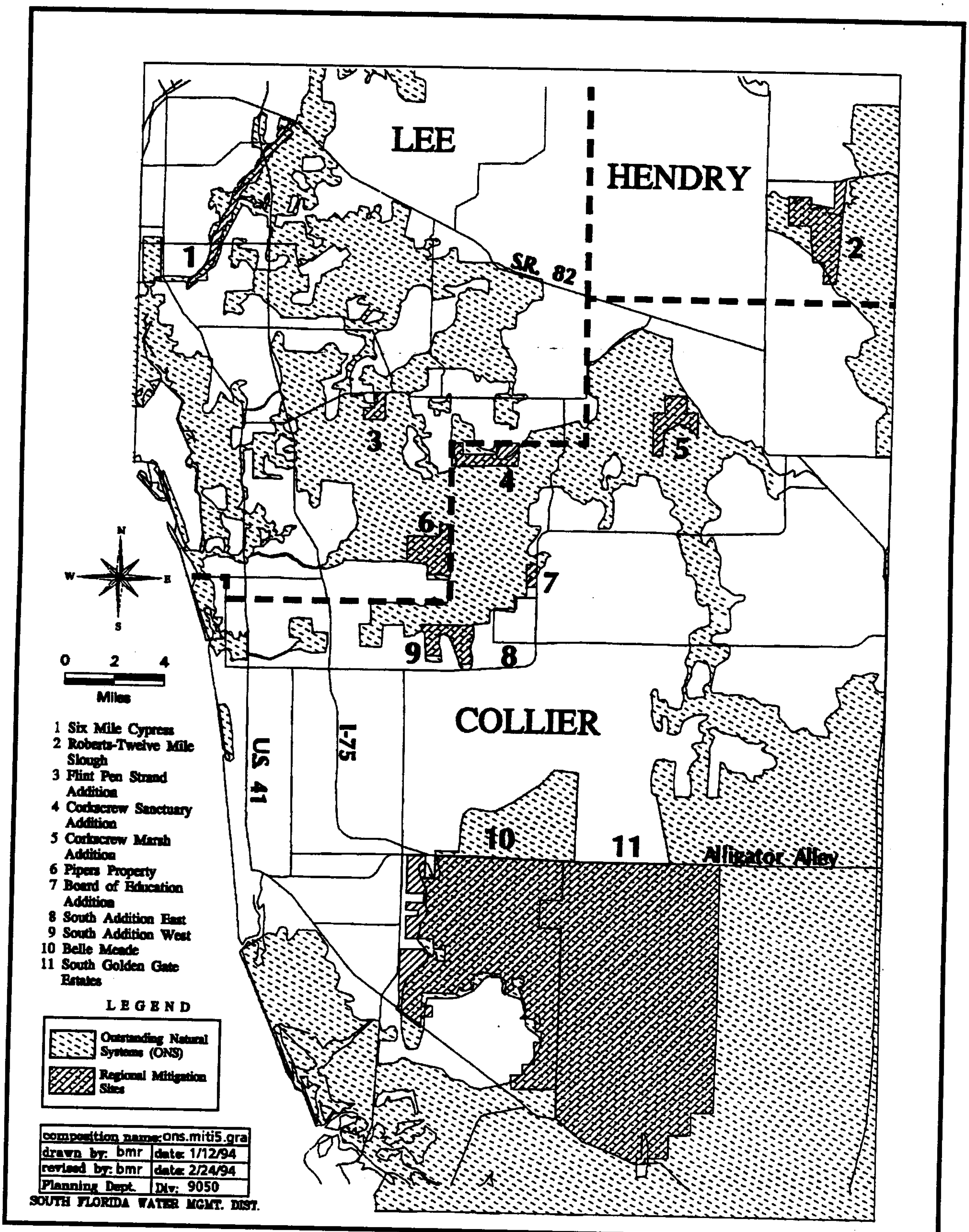

FIGURE VI-2. Outstanding Natural Systems with Regional Mitigation Sites.

TABLE VI-I. Mitigation Banking Sites in the LWC Planning Area.

SITE/COMMUNITY TYPE	ACREAGE
1 Six Mile Cypress	
Forested Swamp, Cypress dominated	1,558
Forested Swamp, non-cypress dominated	230
Scrub/Shrub Swamp	1
Freshwater marsh	13
Upland	197
TOTAL	1,999
2 Robert's Twelve Mile Slough	
Forested Swamp, Cypress dominated	4
Forested Swamp, non-cypress dominated	7
Scrub/Shrub Swamp	20
Freshwater marsh	1,993
Upland	1,609
TOTAL	3,633
3 Flint Pen Strand Addition	
Forested Swamp, Cypress dominated	86
Forested Swamp, non-cypress dominated	16
Scrub/Shrub swamp	0
Freshwater marsh	6
Upland	431
TOTAL	539
4 Corkscrew Sanctuary Addition	
Forested Swamp, Cypress dominated	404
Forested Swamp, non-cypress dominated	188
Scrub/Shrub Swamp	57
Freshwater marsh	22
Upland	759
TOTAL	1,430
5 Corkscrew Marsh Addition	
Forested swamp, Cypress dominated	110
Forested Swamp, non-cypress dominated	124
Scrub/Shrub swamp	211
Freshwater marsh	343
Upland	851
TOTAL	1,639

TABLE VI-I. Mitigation Banking Sites (Continued).

SITE/COMMUNITY TYPE	ACREAGE
6 Pipers Property	
Forested Swamp, Cypress dominated	1,648
Forested Swamp, non-cypress dominated	302
Scrub/Shrub Swamp	13
Freshwater marsh	31
Upland	35
TOTAL	2,029
7 Board of Education Addition	
Forested Swamp, ~~Cypress dominated~~	145
Forested Swamp, non-cypress dominated	19
Scrub/Shrub Swamp	2
Freshwater marsh	56
Upland	86
TOTAL	308
8 South Addition East	
Forested Swamp, Cypress dominated	710
Forested Swamp, non-cypress dominated	161
Scrub/Shrub Swamp	155
Freshwater marsh	79
Upland	1,027
TOTAL	2,132
9 South Addition West	
Forested Swamp, Cypress dominated	570
Forested Swamp, non-cypress dominated	691
Scrub/Shrub Swamp	23
Freshwater marsh	38
Upland	366
TOTAL	1,688
10 Belle Meade	
Forested Swamp, Cypress dominated	15,919
Forested Swamp, non-cypress dominated	5,705
Scrub/Shrub Swamp	1,996
Freshwater marsh	690
Upland	4,515
TOTAL	28,825
11 South Golden Gate Estate	
Forested Swamp, Cypress dominated	21,306
Forested Swamp, non-cypress dominated	18,828
Scrub/Shrub Swamp	5,628
Freshwater marsh	7,343
Upland	3,303
TOTAL	56,408

Other District Implementation Alternatives

The District has a variety of methods of implementing the LWC Water Supply Plan beyond those described above. Many of the alternatives described earlier are regulatory in nature. However, the District influences water supply in other ways than regulation of the supply. Examples of other District functions that can be evaluated when addressing water supply issues follow.

Operations and Maintenance

Alternatives will be considered which alter the levels and timing of water in the District managed canals. Water levels in the shallow aquifers can be influenced by the management of the District's canals. Existing structures can be raised and releases can be timed to meet water supply objectives for specific geographic areas.

Research

The District can perform research on issues related to water supply problems in the LWC Planning Area. An example of this is the wetland impact research initiative. The District has initiated a research effort to evaluate the potential impacts to natural systems by adjacent water withdrawals. This effort will be managed by the Department of Research in cooperation with the Planning Department. The ONS map described in Chapter III will be utilized to focus the research program. The ONS areas will be compared with simulations of water table aquifer drawdowns for the year 2010. Areas that have the most potential for impacts will be identified and used to target the research effort.

Land Acquisition

The District has an active land acquisition program. The program is designed to address the mission of the District which includes water supply. The SFWMD uses federal and state agency monies, combined with monies from its own sources, to purchase lands throughout the 16 county boundary, including the LWC Planning Area. This is an alternative that will be considered by the LWC Water Supply Plan.

Review of Local Comprehensive Plans

The SFWMD has been charged with providing comments on local government comprehensive plans when they are first prepared and when they are amended. Land use, environmental, and utility issues can be addressed through this process to further the objectives of the LWC Water Supply Plan.

Cooperative Actions

Alternative solutions to water supply problems in the LWC Planning Area will be considered that involve agencies and groups other than the District. In fact, it will be imperative that others participate in the solution of the problems. Below is a brief description of some of the actions that agencies and groups other than the District could implement.

Management Agreements

In areas where competing uses will exceed the identified source, management agreements which address issues such as well locations, withdrawal amounts and timing, and environmental impacts may be the appropriate means for users to better manage the resource and increase the certainty of their supply.

Regional Water Supply Authorities (RWSAs) and Interconnects

The Lee County RWSA is the only RWSA in the LWC Planning Area. The RWSA has been charged with providing a long-term and reliable source of water for the urban utilities in Lee County. The RWSA is investigating numerous alternatives, including utility interconnects, which will be considered for use in the LWC Water Supply Plan.

Reuse Systems

Reuse systems have been used successfully in the LWC Planning Area, particularly Cape Coral. These systems have proven useful in freeing up water that would otherwise be lost from the water supply inventory. Problem areas identified in the LWC Planning Area may be targeted for new or expanded reuse systems to prolong water supply sources.

On-Site Storage

On-site storage of water to meet water supply objectives is an alternative that can be considered in specific cases in the LWC Planning Area. It is unlikely that on-site storage can address regional water supply issues; however, it can be used to offset local water supply and environmental issues and will therefore be considered in this plan.

Water Shortage Assumptions of Risk

The District's water shortage triggers will set levels at which point users can expect water use cutbacks to be implemented by use class. Some users may choose to accept a higher incidence of mandatory cutbacks by continuing to use water at a given location which routinely triggers declaration of water shortage restrictions. The District will accept such users' tolerance of a less certain supply, but only within a defined return frequency. For example, a public water supply may attempt to develop a coastal wellfield to such a point that water shortage triggers for Phase III restrictions will be activated every other year. The District would strive to prevent frequent water shortages caused by such withdrawals. However, a less frequent and severe incidence of water shortage triggering would be tolerable.

Wellfield Development and Relocation/Protection

If the resource protection criteria and water shortage triggers indicate to a particular user that present or future intended well locations may be precarious due to significant potential to cause resource impacts, such user should consider well relocation and development in less jeopardized locations.

Water Shortage Planning

During drought conditions, when the drought frequency events assumed in the modeling assumptions are exceeded, restrictions on water usage will be phased in to restrict demands on the natural system. The determining factors, called water shortage indicators, for initiation of water shortages include: (1) trigger levels in aquifers, (2) the presence of salinity in monitoring wells/ground water gradients identifying saltwater intrusion, and (3) reduced ground water levels in selected environmental areas or public water supply production areas. Once a water shortage is declared, the District's Water Shortage Plan will be implemented and will curtail water usage by use class within the specific water shortage declaration areas.